Title: The Dilemma of the Three Little Pigs -- With What Shall I Frame My House?

Brief Overview:

Students will be able to draw a scale model of the exterior frame of their dream home. They will be given a budget and choice of building materials. The ultimate goal is to build the most cost efficient house for the money. They must justify why they used the building materials and the size of their house.

A possible field trip to a lumber or brick yard might be a nice introduction to this learning unit. They must keep a daily journal explaining their decisions and any changes that they might make. In cooperative groups, they will construct a 3-dimensional model of their house out of inexpensive materials of their choice.

Links to NCTM 2000 Standards:

- **Mathematics as Problem Solving**
  Students will demonstrate their ability to work cooperatively in groups to solve a real-life problem of building the frame of a house while staying within a certain budget.

- **Mathematics as Reasoning and Proof**
  Students will demonstrate their ability to use critical thinking skills by deciding as a cooperative group the best material to use for their houses.

- **Mathematics as Communication**
  Students will keep a daily journal explaining the uses of mathematics in each step from calculating the amount of materials to graphing the linear relationship between square footage and cost. Students will be required to write a business letter requesting information on costs of materials.

- **Mathematics as Connections**
  Students will demonstrate their ability to investigate connections between measurement, geometry, and real-life mathematical applications.

- **Mathematics as Representation**
  Students will demonstration their ability in representation by both drawing and building models to scale. Comparisons will be made after graphing linear relationships.

- **Number and Operation**
  Students will demonstrate their ability to use ratios in graphing and building their model house to scale.

- **Geometry and Spatial Sense**
  Students will analyze characteristics and properties of two- and three-dimensional geometric objects and will use visualization and spatial reasoning to solve problems both within and outside of mathematics.

- **Measurement**
  Students will understand attributes, units, and systems of measurement and apply a variety of techniques, tools, and formulas for determining measurements.

Grade/Level:

This learning unit is designed for Grades 6-8.

Duration/Length:

This project will take 7 or 8 class periods, best suited to begin on a Thursday and incorporate two weekends.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Rules for proportions and ratios
- Scale drawings
- Concept of area, surface area, perimeter
- Graphs
- Working knowledge of Internet
- Use of calculator

Student Outcomes:

Students will:

- calculate proportions/ratios, square footage, surface area, perimeter, and costs.
- understand working within budget constraints.
- be able to write a formal business letter.
- be able to building two- and three-dimensional models to scale.
- gain experience in speaking in front of a group when presenting project.
- learn how to compare with use of graphs.
- learn how to keep daily journal.

Materials/Resources/Printed Materials:

- Paper/pencil
- Graph paper
- Ruler
- Journal composition notebook
- Calculator
- Computer with Internet access
- Three-dimensional building materials: (options) Legos, popsicle sticks, glue, paint, heavy stock cardboard for base, etc.
- Samples of building bricks (optional)
- Samples of vinyl siding (optional)

Development/Procedures:

Day 1:

- Present the building project to the students.
- Tell students to keep a daily math journal explaining their comprehension of the daily lessons.
- Emphasize that there is a specified budget for this project that they must stay within ($20,000).
- Discuss the materials to be used for the “actual “ exterior of home (these may be specified by the teacher or left to the students’ discretion).
- Review the rules for proportions and ratios.
- Review with students how to use graph paper in scale drawings.

- Emphasize that ratios must be shown on scale drawing.
- Hand out Worksheet #1 which is due on Day 2.

Day 2:

- Groups of no more than 4 students will be formed.
- Collect Worksheet #1 and check off that it was completed while students break into groups.
- Class discussion will take place on the purpose of the lesson which is to build the largest house while staying within the budget.
- Each group will discuss their ideas and will need to form a consensus on the size and shape of the house their group will build.
- On Worksheet #2, each student will calculate perimeter, surface area, and actual area of living space (square footage) of cooperative house.
- Students should access the Internet or newspaper (usually in weekend section) for information on house floor plans and building materials. Information should be brought to the next class.
- Hand out four sheets of graph paper. Depending on the size of their house they can use one sheet or tape four together to make one large rectangular sheet.
- Each student will bring a scale drawing of house to class on Day 3.

Day 3:

- Have a speaker presentation on actual real-life considerations when building a house.
- Hand out price list of different building materials.
- Show students actual building bricks and sample of vinyl siding.
- Scale drawings will be collected.
- For homework, students will calculate the amount of materials needed using measurements from Worksheet #2.
- Students will write a formal business letter to a building supply company requesting prices and comparisons of building materials (this will be done in cooperation with the Language Arts teacher).
- Students need to write their justification for the building materials they decided to use.

Day 4:

- Students in groups will make adjustments to their scale drawings and proportions. As a group, they will decide on their building materials (keeping within the budget).
- A cooperative scale drawings will need to be redrawn neatly and accurately.
- Remind students that all decisions made by the group need to be recorded and reflected on in their journal.

Days 5 & 6:

- Students will construct a three-dimensional model of their home. Students can either be instructed to use certain materials or their own imaginations.
- Students should be reminded that their three-dimensional model's building material must be shown to be proportional to actual building materials.
- Students should be told that wood homes, scale and actual, must be painted and cost of paint must be included.

Day 7:

- Students will present and explain their drawings and three-dimensional models to the teacher and students.

- Collect data (square footage and cost) from all groups and using a vertical bar graph, graph the relationship between square footage and cost (see teacher appendage).
- Conduct a discussion with students about homes being cost and energy efficient.
- Tell students that homes are to be built in an area with temperature variance.
- Collect journals and models.

Assessment:

Assessment will be a combination of individual activities and final evaluation of the three-dimensional model with consideration of budget, construction, design, and written justification. Neatness and actual project feasibility will also be taken into account. Each student will keep a daily journal on their thoughts during the project. Students will be graded on their presentation of their project to the teacher and class.

Extension/Follow Up:

The students could explore the topic of energy conservation and the how the use of different building materials plays an important role in energy efficiency and in keeping costs minimized.

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Worksheet #1

Name_____

1. Pretend you were going to build the most desirable house you could within a certain budget. What would you do first?

2. When thinking about building this house, what dimensions would you need to take into consideration to frame it?

3. Of the dimensions you would need (from Question 2), what do you think would be reasonable measurements for each? To help you with this, take a look at a few real houses, measure them and/or talk to your parents for their input.

4. Now using the information from Question 3, calculate the perimeter, square footage, and the total exterior surface area (be **careful** to include the gable area).

   Perimeter _____ft.

   Square footage _____sq. ft.

   Surface area _____sq. ft.

5. Now think about the choices you have in building materials. What type of material would you like to use for your most desirable house? Why?

Worksheet #2

Name_____ Group Name_____

After your group discusses and agrees on the size and shape of the house you want to build cooperatively, each of you need to complete this worksheet.

1. Calculate the perimeter, square footage, and surface area.

   Perimeter _____

   Square footage _____

   Surface area _____

After the speaker presentation and using the price list information, discuss and decide which type of building materials you will use.

2. Using measurements from #1, calculate the amount of materials you will need for the following types of exterior framing materials.

   Wood/Paint _____

   Wood/Vinyl Siding _____

   Wood/Brick Veneer _____

   Brick/Brick _____

   Other _____

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3. Using price list and figures from #2, calculate the costs of the following.

   Wood/Paint _____

   Wood/Vinyl Siding _____

   Wood/Brick Veneer _____

   Brick/Brick _____

   Other _____

Price List

for Building Materials

Wood framing per square ft.	$_____
Brick per cord(500)	$_____
Paint per sq. ft .	$_____
Vinyl siding per 100 sq. ft.	$_____
Wood siding per 100 sq. ft.	$_____

Dimensions of:

Standard Brick	3” x 8”
Vinyl Siding	5” x 8’
Wood Siding	Varies depending on type of wood siding

Teacher Notes

Before beginning this project, the teacher should research the costs of the types of building materials used in their geographic region and then set a reasonable dollar limit for the students to use as their maximum to spend. In our class we used $20,000 to frame an average size house.

If possible, coordinate this lesson with the Language Arts teacher. He/she would instruct and help grade both the formal business letter and the students' oral presentations.

If you have Internet access on Day 1, you might want to introduce this lesson by surfing the web for floor plans and architectural designs.

If possible, contact a speaker for Day 3. Some suggestions would be to find a vocation technical instructor, a building contractor, or a supervisor at a lumber or brick yard. Parents can be a good resource.

At the very end of this learning unit when all the groups have made their presentations, take the data (total square footage, total cost, and type of material used) from each group and have the students draw a graph and look for comparisons.

RUBRIC FOR WORKSHEET #1

THREE POINTS:
A) All calculations were correctly computed.
B) Questions were thought out and answered.
C) Work was done neatly.

TWO POINTS:
Any two of the above criteria were covered.

ONE POINT:
Either (A) or (B) was covered.

ZERO POINTS
Worksheet was not attempted.

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RUBRIC FOR SCALE DRAWING

THREE POINTS:
A) Drawing is done to scale.
B) All ratios are shown and done correctly.
C) Drawing is neat.

TWO POINTS:
A) Drawing is done to scale.
B) All ratios are shown and done correctly.

ONE POINT:
A) Drawing was attempted but not to scale.

ZERO POINTS:
Student did not attempt assignment.

RUBRIC FOR WORKSHEET #2

Find the percentage of the total correct answers. Keep in mind that the units of measurement must be correctly stated. This worksheet may be counted as three individual parts or as one total worksheet. Questions 2 and 3 have an option "Other", that the teacher can decide to count as extra credit or part of the assignment.

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RUBRIC FOR JOURNALS

THREE POINTS:

A) Journal entry for each day was in complete sentences.
B) Entries were justified from data where appropriate.
C) Entries showed creative and original thought.

TWO POINTS:

Two of the above criteria were covered.

ONE POINT:

One of the above criteria was covered.

ZERO POINTS:

Journal was not attempted.

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RUBRIC FOR THREE-DIMENSIONAL MODEL

FOUR POINTS:

A) Model is done to scale.
B) Creativity is shown in construction.
C) Ratios are shown and explained.
D) Model displays care and time spent.

THREE POINTS:

Three of the above criteria were met.

TWO POINTS:

Two of the above criteria were met.

ONE POINT:

One of the above criteria was met.

ZERO POINTS:

Three-dimensional point was not attempted.

RUBRIC FOR GRAPH

FOUR POINTS:

A) Graph has a title.
B) X and Y axes are correctly labeled.
C) X and Y axes have appropriate and consistent intervals.
D) The graph is correct.

THREE POINTS:

Any three of the above criteria are displayed.

TWO POINTS:

Any two of the above criteria are displayed.

ONE POINT:

Any one of the above criteria is displayed.

ZERO POINTS:

Graph was not even attempted.